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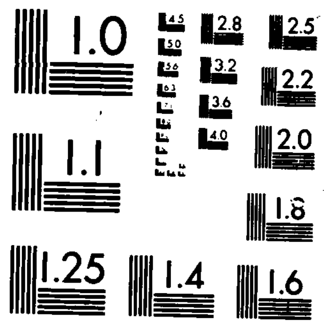

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COMPARISON OF MEROPLANKTON MONITORING FROM A FIXED PLATFORM WITH MONITORING FROM TOWED COLLECTIONS

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for

The U.S. Army Corps of Engineers,
Norfolk District

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Conclusion is that fixed platform sampling is as good an estimator of density of dominant meroplanktons as that provided by towed samples. Advantage of fixed sampling is that it is less expensive, less weather dependant and will provide continuity of data over time (valuable in long-term monitoring).

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INTRODUCTION

Long-term monitoring studies of non-commercial marine organisms are rare, especially studies of zooplankton populations. Where such data bases exist they are frequently the source of unique and valuable information. The importance of long-term data bases is the continuity of data over time hence their maximum value is only realized after a number of iterations of the ecological cycle under study. Unfortunately, the vagaries of funding rarely allow the consistent and persistent collection of long-term biological data sets. We have reasoned that the likelyhood of long-term support for such projects is inversely proportional to the amount of required funding. This study was undertaken to test the feasibility of monitoring meroplankton from a fixed platform, a less expensive and less weather dependent mode of sampling than the traditional method of towed collections.

The fixed platform selected for the study was the fishing pier adjacent to Thimble Shoal Channel on the southernmost tunnel island of the Chesapeake Bay Bridge-Tunnel. This site was chosen because it was near several stations being sampled from a boat by towed nets in a companion study, and being located in the Bay mouth, it seemed an appropriate monitoring site.

Here we report on a statistical comparison of the pier collections with the towed collections and evaluate the fixed platform sampling technique.

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SAMPLING REGIME AND METHODOLOGY

Meroplankton sampling was conducted semi-monthly in the lower Chesapeake Bay at three towed stations (Stations 1, 2, and 4) from May 1982 through October 1983 and at a platform station (Station 3) from January 1982 through December 1983. Only data from May through October in both years was included in the analysis.

The platform station was located at the end of the fishing pier which extends from the South Island of the Chesapeake Bay Bridge-Tunnel contiguous to the Thimble Shoal Channel. The platform station was flanked by Station 4, located approximatly 1.9 nautical miles to the west in Thimble Shoal Channel, and Station 2, located approximatly 2.3 nautical miles to the east in the same channel. Station 1 was located approximatly 10.8 nautical miles ESE of the platform near Chesapeake Channel Buoy "CBB". The relative locations of these stations is illustrated in Figure 1.

Since collection methods and gear design differed somewhat between the towed stations and the platform station each will be discussed separately.

Platform Collections

At the platform station samples were taken at the following discrete depths:

(1) surface (neuston)

(2) one meter below the surface (sta. 3A)

(3) one meter above the bottom (sta. 3B)

(4) benthic

For ease of statistical comparison each of the discrete sampling depths at the pier location are treated as separate stations. Since no comparable towed collections were available for comparison with the platform benthic collections, they were omitted from the analyses.

Two types of net frames were employed, both fitted with 353 micron mesh conical nets with 0.5 m diameter openings. Neuston samples were taken with the net fitted to a rectangular frame 21.5 cm x 55.5 cm yielding a mouth area of 1193.25 sq. cm. The net was fitted with side floats which held the upper portion of the frame above the surface and yielded an effective fishing area of approximately 895 sq. cm. Neuston collections consisted of three serial replicates of fifteen minutes duration.

Samples taken from 1 m below the surface and 1 m above the bottom were taken with the nets fitted to a 0.5 m diameter circular bongo frame which yielded a mouth area of 1963.5 sq. cm. Since this yielded two simultaneous replicates, the gear was fished for two fifteen minute sets at each depth during a series to produce two serial sets of two simultaneous replicates. All four replicates were treated the same. All nets were equipped with torpedo type flow meters with "low flow" rotors (General Oceanics model #2030). All samples were concentrated into one quart containers and preserved in the field in 7% formalin in seawater.

Passive sampling usually samples a smaller volume of water than towed samples of the same duration, consequently, in this study, sampling was conducted on or near the new and full moons when tidal currents were presumed to be at their maximum. For the first nine months of the study, January 1982 to September 1982, sampling was conducted on both the ebb and flood tides near the presumed time of maximum flow. This sampling protocol presented many difficulties, as outlined below, and was abandoned in October 1982 for a single series of samples on each sampling date taken without regard to tidal stage. The original protocol presented the following problems:

(1) Current speed and sometimes direction near the surface were partially, but importantly dependent upon wind speed and direction and freshwater outflow of the bay drainage systems.

(2) Time of tide change and maximum ebb and flood were impossible to anticipate within the limits required by the protocol.

(3) Time of maximum velocity of near-surface and near-bottom waters were usually out of phase, sometimes by several hours. Direction of flow differed in surface and bottom waters during a portion of each tidal cycle and on occassion throughout an entire tide phase.

Towed Stations

Towed plankton stations (Stations 1, 2, and 4) were collected using oblique tows from approximately one meter above the bottom to the surface with 0.5 m bongo nets of 355 um mesh. Replicate tows immediately followed. These tows varied somewhat in duration due to the difference in water depths at the three stations and the oblique nature of the tows. In addition, the top 12-15 cm of the sea surface was sampled with a one meter neuston net at Station 1 where four replicate five minute neuston tows were made. Mechanical flow meters were used on all nets and collections were preserved in 7% buffered formalin the field.

Laboratory Processing

Both towed and fixed platform samples were processed in esentially the same manner in the laboratory; however, the two sets of samples were processed in different laboratories using different sorters. The two laboratories coordinated identifications and exchanged species lists during the study.

In the laboratory, samples were split as required following the "CVS" method of Alden, et al (1982). Splits were accomplished with a Folsom plankton splitter and subsamples were randomly selected for sorting. All meroplankton in each subsample sorted were enumerated and identified to the lowest taxonomic level possible under the budgetary constraints of the project. After sorting, subsamples were recombined and all samples are archived at Old Dominion University, Norfolk, Virginia.

All data were standardized to number of individuals per cubic meter before analysis. The possibility that differences existed in the identification of relatively rare taxa by the two independent groups of lab workers dictated that only the more common meroplankton taxa be included in the analysis. The data sets used in the analysis below are, therefore, a subset of the combined data set composed of the top 20 dominant taxa from each of the sampling techniques.

RESULTS

Comparison of Neuston Collections

The top 22 taxa for both towed and platform neuston collections in 1982 and 1983 and their average density per cubic meter are presented in Tables 1 and 2. It should be noted that towed neuston collections were only made at station 1, hense comparison of these data are of only stations 1 and 3.

A oneway analysis of variance on the 22 major taxa showed no significant difference between the average counts per cubic meter for the platform samples and towed samples for all but two species in each year. In 1982 there was a significant difference for *Lucifer* sp. ($p < 0.05$) and a highly significant difference ($p < 0.01$) for Sciaenidae eggs. In 1983 there was a significant difference ($p < 0.05$) for *Scophthalmus aquosus* larvae and a highly significant

difference ($p < 0.001$) for Sciaenidae eggs. In both years Sciaenidae eggs were significantly more abundant in the tows (2.63 and 6.45 per m^3) than in the platform catches (0.29 and 0.63 per m^3). The average counts for Scophthalmus aquosus larvae and Lucifer sp. were quite low and these significant differences were probably fortuitous.

A multivariate analysis of variance indicates that for both 1982 and 1983 there is a highly significant difference ($p < 0.001$) between the platform neuston samples and the neuston tows. In order to determine the magnitude of this difference and the contribution of the individual species to the difference a discriminant analysis was run for each year. Different species were important in discriminating between the two stations in 1982 and 1983, however the overall results were similar. In 1982 xanthid crab zoea, pagurid crab zoea, Crangon, Lucifer, sciaenid eggs, and other fish eggs were the discriminating variables. In 1983 Callinectes sapidus zoea, Uca spp, spionids, bivalves, gastropods, sciaenid eggs, other fish eggs, and Scophthalmus aquosus larvae were the discriminating variables. In 1982 78% of the collections were correctly classified (table 3) while in 1983 85% of the cases were correctly classified (table 4). The majority of the misclassifications were in the towed samples, indicating that these samples were much more variable than the platform samples.

Comparison of Subsurface Collections :

Mean values and sample size for each species at each station for 1982 and 1983 are presented in Tables 5 and 6, respectively. Univariate analysis of variance shows significant differences ($p < 0.05$) between the station means for 1982 for 14 of the 22 taxa. Results for 1983 were similar to 1982.

The results of multivariate analysis are shown in Tables 7-10. The centroids of the groups were all significantly different in a multivariate sense ($p < 0.005$) for both years (Tables 7 and 8); however, there was a great deal of overlap between groups as shown in Tables 9 and 10. Figures 2 and 3 show the 95% probability elipses for the first two discriminant functions for 1982 and 1983. These figures also show a great deal of overlap between the groups and also indicate that the variation in the platform groups is substantially smaller than in the tows.

DISCUSSION

It appears from the preceeding analysis that the fixed platform sampling approach is as good an estimator at a given site of the density of the dominant groups of meroplankters as that provided by towed samples. Neuston samples showed significant differences for both years between the two techniques only for Sciaenidae eggs. This difference is almost certainly due to station location. Sciaenidae eggs in subsurface samples, where all four locations were sampled,

also show significant differences ($p < 0.05$) between the two offshore stations (stations 1 & 2) and the inshore stations (stations 3A, 3B & 4). Additional evidence that differences between stations is primarily due to station location as opposed to collecting technique is provided by the fact that station 4 most frequently misclassifies with station 3A than with the other towed stations further offshore (see Table 10).

We believe the greater variability in towed stations is largely the result of these collections being taken across the entire water column as opposed to the discrete depth samples taken at the pier station.

LITERATURE CITED

Alden, R. W. III, R. C. Dahiya, and R. J. Young, Jr. 1982. A method for the enumeration of zooplankton subsamples. J. Mar. Biol. Ecol., Vol. 59, pp. 185-206.

Table 1. Mean number of neuston/m^3 for tow and platform for 1982. Means followed by different letters are significantly different at the 0.05 level.

Species	Mean # organisms per m^3		
	Tow	Platform	Total
Callinectes sapidus megalopa	0.0283	0.0050	0.0139
Callinectes sapidus zoea	20.4679	107.4172	74.2936
Cancer irroratus zoea	0.1916	49.3843	30.6442
Upogebia affinis	13.2331	9.2259	10.7524
Xanthid spp.	0.5712	23.4118	14.7106
Pinnixa spp.	0.1131	7.9665	4.9747
Pinnotheres spp.	0.1856	2.5095	1.6242
Uca spp.	3.0379	9.6200	7.1125
Pagurid spp. zoea	0.0751	0.0476	0.0581
Crangon septemspinosa	4.1981	0.9611	2.1942
Lucifer spp.	0.1270[a]	0.0262[b]	0.0646
Callianassa spp.	0.7552	0.5594	0.6340
Spionid spp.	0.0058	1.2384	0.7688
Bivalves	0.0102	0.1993	0.1273
Gastropods	0.7651	11.5631	7.4496
Anchoa mitchilli eggs	193.4874	948.0703	660.6102
Flat fish spp. eggs	0.0013	13.1374	8.1332
Sciaenidae eggs	6.4546[a]	0.6338[b]	2.8512
Other fish eggs	0.0010	2.6529	1.6426
Scophthalmus aquosus larvae	0.0000	0.0000	0.0000
Trinectes maculatus larvae	0.0000	0.0000	0.0000
Anchoa mitchilli larvae	0.1877	3.2744	2.0985

Table 2. Mean number of neuston/m^3 for tow and platform for 1983. Means followed by different letters are significantly different at the 0.05 level.

Species	Mean # Organisms per m^3		
	Tow	Platform	Total
Callinectes sapidus megalopa	0.0022	0.1094	0.0804
Callinectes sapidus zoea	5.1267	44.0792	33.5515
Cancer irroratus zoea	0.0210	2.5519	1.8679
Upogebia affinis	0.1172	0.4183	0.3369
Xanthid spp.	0.0455	1.7814	1.3122
Pinnixa spp.	0.0004	0.4264	0.3112
Pinnotheres spp.	0.0034	0.4554	0.3332
Uca spp.	0.0643	3.7280	2.7378
Pagurid spp. zoea	0.0026	0.1719	0.1262
Crangon septemspinosa	0.8362	3.8994	3.0715
Lucifer spp.	0.1329	0.9730	0.7460
Callianassa spp.	0.0045	0.1708	0.1259
Spionid spp.	0.0259	4.7888	3.5015
Bivalves	0.0011	0.0339	0.0251
Gastropods	0.0226	0.2702	0.2033
Anchoa mitchilli eggs	32.4304	39.7629	37.7812
Flat fish spp. eggs	0.0018	7.1978	5.2530
Sciaenidae eggs	2.6299[a]	0.2927[b]	0.9244
Other fish eggs	4.9441	16.6034	13.4522
Scophthalmus aquosus larvae	0.0047[a]	0.0000[b]	0.0013
Trinectes maculatus larvae	0.0000	0.0045	0.0033
Anchoa mitchilli larvae	0.0058	0.1948	0.1437

Table 3. Classification analysis for the 1982 neuston samples.

Actual Station	# of Cases	Predicted Station: Tow	Predicted Station: Platform
Tow	24	13 (54.2%)	11 (45.8%)
Platform	39	3 (7.7%)	36 (92.3%)

Table 4. Classification analysis for the 1983 neuston samples.

Actual station	# of Cases	Predicted station: Tow	Predicted station: Platform
Tow	20	10 (50%)	10 (50%)
Platform	54	1 (1.9%)	53 (98.1%)

Table 5. Mean number / m^3 and sample size at each station for 1982. Means followed by different letters are significantly different at the 5% level.

Species	Sta. 1	Sta. 2	Sta. 3A	Sta. 3B	Sta. 4
Callinectes sapidus megalopa	0.0000	0.0174	0.1704	0.6299	0.0222
Callinectes sapidus zoea	2.9922	26.5957	16.6190	16.2261	5.0007
Cancer irroratus zoea	0.2119^{ab}	0.8673^{b}	0.3157^{ab}	0.2413^{ab}	0.0365^{a}
Upogebia affinis	0.6598^{a}	8.2966^{a}	4.4863^{a}	15.7104^{b}	7.7190^{a}
Xanthid spp.	0.3709^{a}	4.4539^{a}	6.5523^{a}	11.6283^{b}	2.1815^{a}
Pinnixa spp.	0.5122^{a}	3.8850^{a}	1.0151^{a}	14.6208^{b}	2.3519^{a}
Pinnotheres spp.	0.3377^{a}	3.7534^{a}	0.7255^{a}	15.4840^{b}	2.5745^{a}
Uca spp.	0.6772^{a}	3.4213^{ab}	1.7726^{a}	5.1358^{b}	0.7657^{a}
Pagurid spp. zoea	1.3745^{a}	12.2057^{b}	0.2353^{a}	2.2062^{a}	0.9190^{a}
Crangon septemspinosa	82.9512^{a}	2.7757^{b}	0.2326^{b}	2.6363^{b}	1.0299^{b}
Lucifer spp.	0.0000^{a}	0.3183^{b}	0.1103^{a}	0.1476^{a}	0.1022^{a}
Callianassa spp.	2.3240^{ab}	2.8857^{b}	0.1795^{a}	1.8847^{ab}	1.1211^{ab}
Spionid spp.	0.3580^{ab}	0.1711^{a}	6.9972^{b}	3.5591^{ab}	0.1185^{a}
Bivalves	0.0046	0.1569	0.0948	2.5126	0.0173
Gastropods	1.8369^{a}	5.6744^{a}	6.8888^{a}	15.5882^{b}	1.5496^{a}
Anchoa mitchilli eggs	27.0158^{ab}	13.9988^{a}	69.0453^{b}	26.8876^{ab}	11.2399^{a}
Flat fish spp. eggs	0.0000	0.5497	1.6388	0.3306	0.0071
Sciaenidae eggs	7.2745^{ab}	15.3397^{b}	0.0332^{a}	0.0662^{a}	1.7396^{a}
Other fish eggs	0.0288	0.3841	0.2034	3.6960	1.1574
Scophthalmus aquosus larvae	0.0011	0.0008	0.0000	0.0000	0.0015
Trinectes maculatus larvae	0.0000	0.0000	0.0144	0.0138	0.0000
Anchoa mitchilli larvae	0.1376	1.0656	1.7760	2.5712	1.5476
Sample size (N)	20	56	75	69	56

Table 6. Mean number / m^3 and sample size at each station for 1983. Means followed by different letters are significantly different at the 5% level.

Species	Sta. 1	Sta. 2	Sta. 3A	Sta. 3B	Sta. 4
Callinectes sapidus megalopa	0.0000	0.0391	0.0027	0.2642	0.0744
Callinectes sapidus zoea	40.9736^{a}	20.6482^{ab}	12.5780^{b}	18.6419^{ab}	9.6856^{b}
Cancer irroratus zoea	0.1965^{ab}	0.1513^{ab}	0.0499^{a}	0.5373^{b}	0.2055^{ab}
Upogebia affinis	2.3519^{a}	8.2430^{ab}	1.8434^{a}	2.7364^{a}	14.1508^{b}
Xanthid spp.	1.6103^{a}	4.6996^{a}	2.8944^{a}	3.9044^{a}	8.2764^{b}
Pinnixa spp.	3.0114^{ab}	7.0175^{c}	0.2792^{a}	3.7876^{b}	2.2774^{ab}
Pinnotheres spp.	3.4459^{a}	1.2944^{ab}	0.4981^{b}	2.6273^{a}	1.8038^{ab}
Uca spp.	4.5490^{ab}	2.5402^{a}	1.8929^{a}	11.3476^{b}	4.1462^{a}
Pagurid spp. zoea	3.1985^{a}	2.8716^{a}	0.1315^{b}	1.1955^{b}	0.7231^{b}
Crangon septemspinosa	41.0493^{a}	12.0583^{b}	12.3537^{b}	10.1017^{b}	6.9222^{b}
Lucifer spp.	0.6235^{a}	0.3784^{ab}	0.0564^{b}	0.2206^{ab}	0.2787^{ab}
Callianassa spp.	0.4928^{ab}	1.4660^{c}	0.0067^{a}	0.8820^{bc}	0.1701^{a}
Spionid spp.	1.1081^{a}	0.7045^{a}	0.8024^{a}	4.0212^{b}	1.8465^{a}
Bivalves	1.4436^{ab}	0.2347^{a}	0.2782^{a}	2.2835^{b}	0.0755^{a}
Gastropods	0.6855	2.0018	1.8848	8.4817	5.5916
Anchoa mitchilli eggs	75.8975^{a}	22.6277^{b}	24.6403^{b}	9.0733^{b}	26.9169^{b}
Flat fish spp. eggs	0.0000^{a}	0.0044^{a}	0.4239^{b}	0.2557^{ab}	0.0000^{a}
Sciaenidae eggs	7.2139^{a}	8.7886^{a}	0.3066^{b}	0.0985^{b}	0.7237^{b}
Other fish eggs	0.0191^{a}	0.1294^{a}	0.8899^{a}	0.2277^{a}	11.8918^{b}
Scophthalmus aquosus larvae	0.0210^{ab}	0.0343^{a}	0.0000^{b}	0.0006^{b}	0.0058^{b}
Trinectes maculatus larvae	0.0041^{ab}	0.0163^{b}	0.0048^{ab}	0.0017^{a}	0.0064^{ab}
Anchoa mitchilli larvae	0.2132^{ab}	2.0102^{b}	0.1958^{a}	0.9311^{ab}	1.6520^{ab}
Sample size (N)	20	44	53	53	43

Table 7. Multivariate F values for comparisons of all stations for 1982. All values are significant (p .005).

Station	1	2	3A	3B
2	4.42			
3A	4.52	5.84		
3B	5.00	4.86	4.37	
4	3.55	2.91	3.22	3.39

Table 8. Multivariate F values for comparisons of all stations for 1983. All values are significant (p .005).

Station	1	2	3A	3B
2	3.79			
3A	5.03	5.75		
3B	5.99	7.21	3.68	
4	5.43	5.40	3.99	5.80

Table 9. Number and (percent) of correctly classified cases for the 1982 sites.

Station	1	2	3A	3B	4
1	4 (20)	2 (10)	1 (5)	0	13 (65)
2	0	24 (43)	5 (9)	4 (7)	23 (41)
3A	0	2 (3)	43 (57)	5 (7)	25 (33)
3B	0	2 (3)	20 (29)	31 (45)	16 (23)
4	0	3 (5)	2 (4)	1 (2)	50 (89)

Table 10. Number and (percent) of correctly classified cases for the 1983 sites.

Station	1	2	3A	3B	4
1	12 (60)	0	5 (25)	3 (15)	0
2	2 (4.5)	20 (45.5)	17 (38.6)	2 (4.5)	3 (6.8)
3A	0	0	48 (90.6)	4 (7.5)	1 (1.9)
3B	1 (1.9)	0	21 (39.6)	29 (54.7)	2 (3.8)
4	1 (2.3)	0	19 (44.2)	2 (4.7)	21 (48.8)

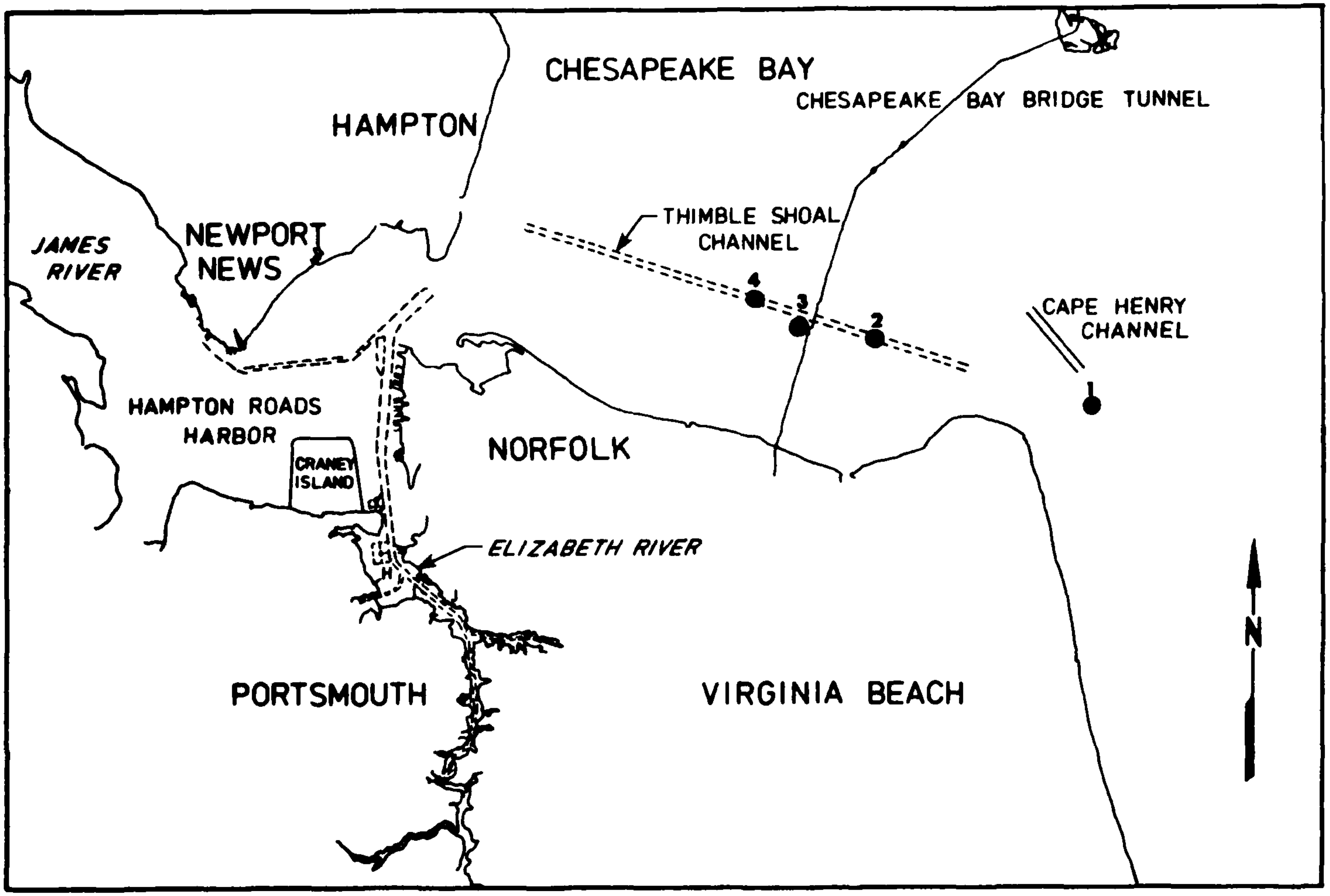

Figure 1. Map of study area. Stations 1, 2, and 4 towed collections; station 3 passive collections; station 3 passive collections.

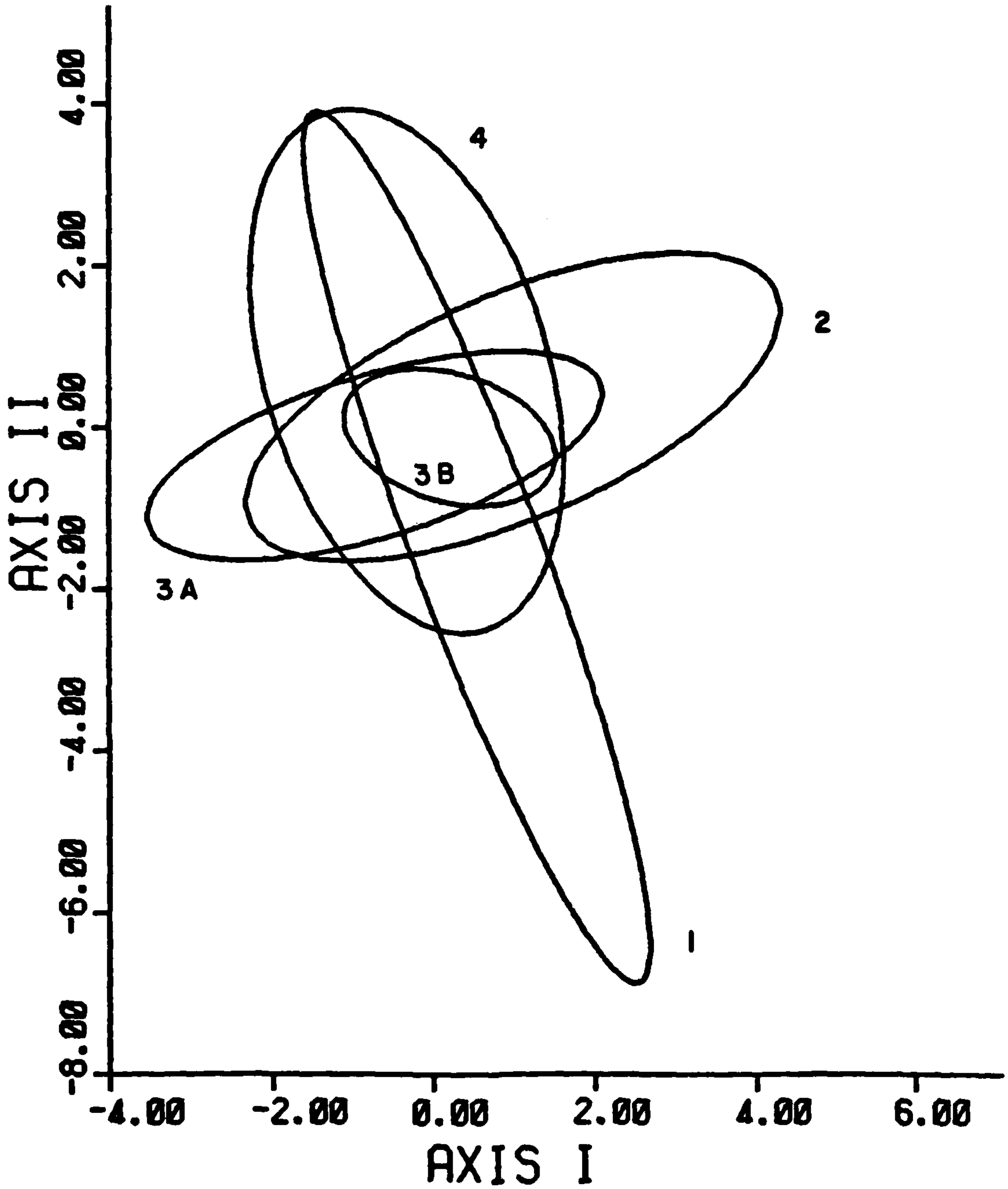

Figure 2. 95% probability elipses for the first two discriminant functions for the 1982 collections. The size of the elipse indicates the degree of heterogeneity of the data. The union of the elipses indicates the degree of overlap of the data.

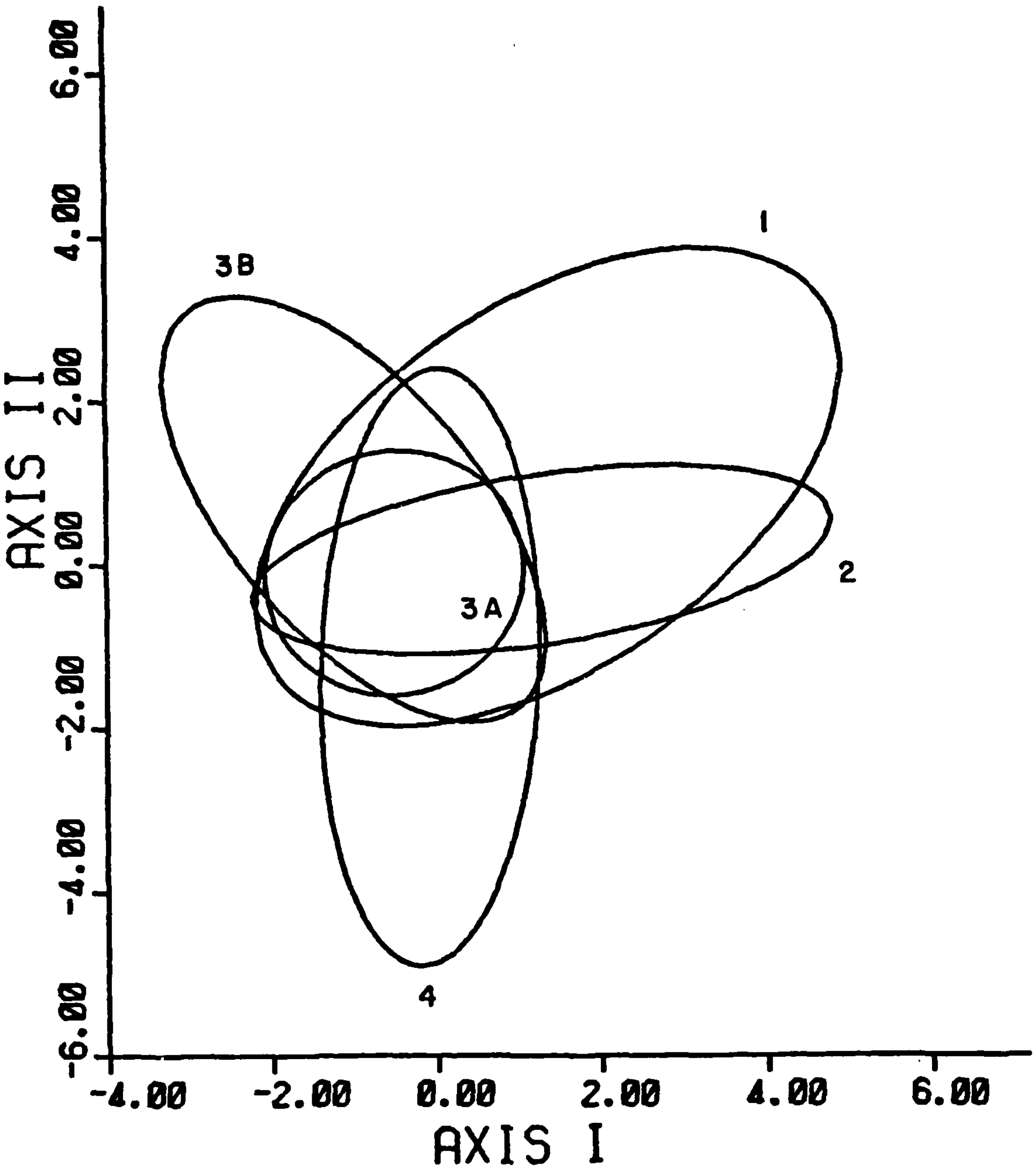

Figure 3. 95% probability elipses for the first two discriminant functions for the 1983 collections. The size of the elipse indicates the degree of heterogeneity of the data. The union of the elipses indicates the degree of overlap of the data.

END

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